Collaborating Hearing Aids

Phonak Meeting

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Outline

Motivations (1/3)

Generalities

- Battery-operated sensing devices
- Types: behind-the-ear (BTE), in-the-ear (ITE), in-the-canal (ITC) and completely-in-the-canal (CTC)

- Analog vs. digital
- Few (omni-)directional microphones, 1 loudspeaker

Motivations (2/3)

Improve speech intelligibility with hearing aids

- Spectral shaping
- Beamforming
- Assistive listening devices

(a) (b)

Figure: Assistive listening devices. (a) Remote microphone. (b) Collaborating hearing aids.

Motivations (3/3)

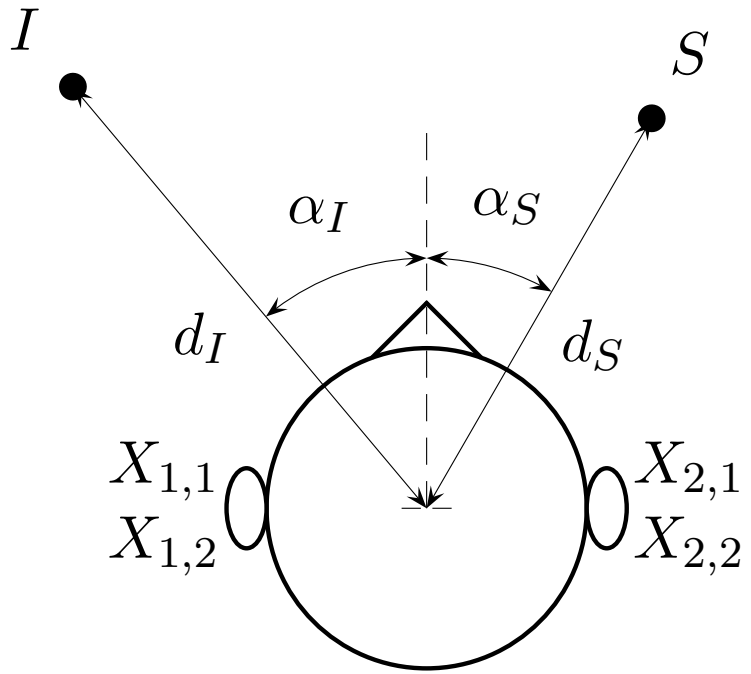
Wireless transmission

- Bluetooth technology
- Analog vs. digital
- Coding issues

Gain-Rate Tradeoff

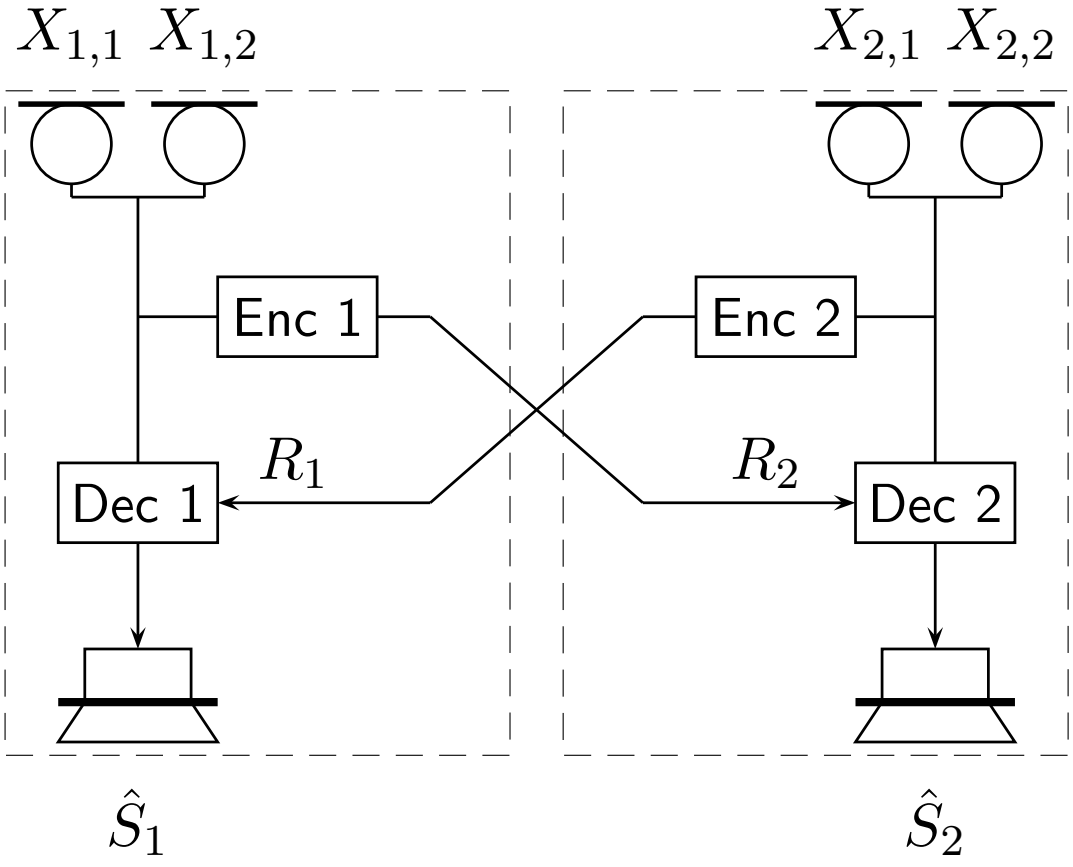
Collaborating Hearing Aids (1/2)

Head-related configuration



Collaborating Hearing Aids (2/2)

Wireless collaboration scheme



Theoretical Gain-Rate Analysis (1/3)

We consider

- Perceptually motivated weighted distortion measure
- Head-shadow effect (HRTF)
- Possible directivity of embedded microphones
- Different classes of coding strategies

We obtain

- Rate allocation across the frequency bands
- Rate allocation between the hearing aids

Theoretical Gain-Rate Analysis (2/3)

- Gain-rate tradeoffs

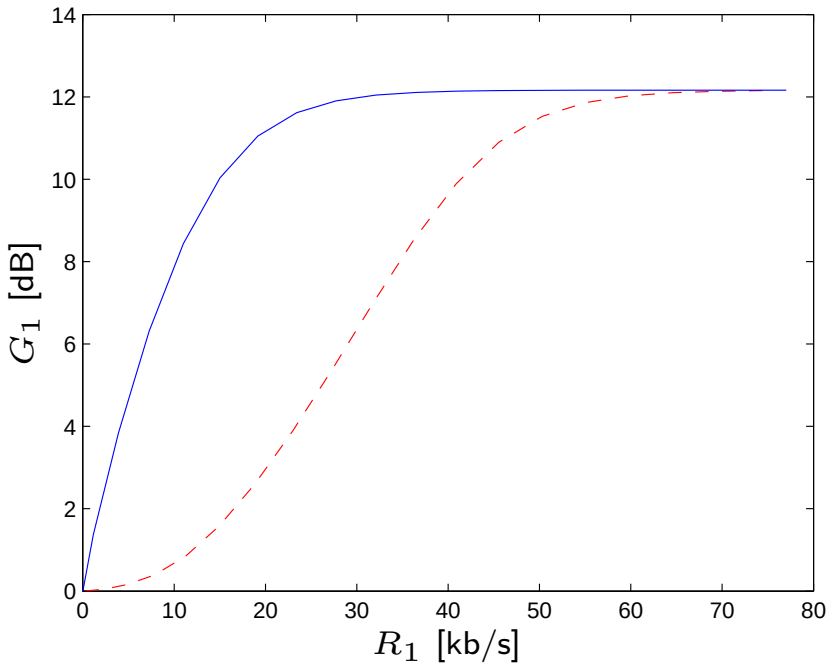
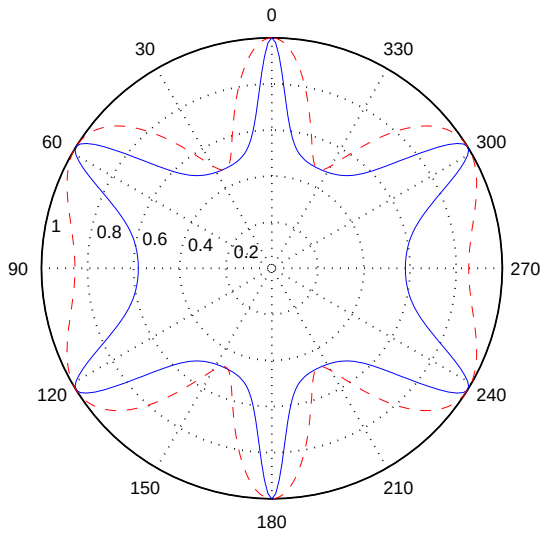


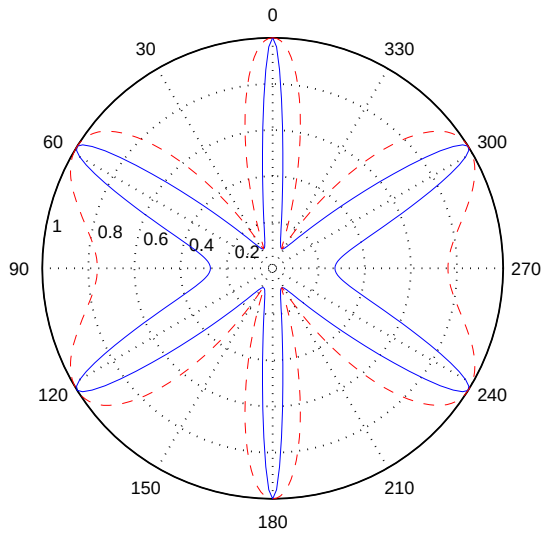
Figure: Examples of gain-rate tradeoffs (two classes of coding strategies).

Theoretical Gain-Rate Analysis (3/3)

- Rate-constrained directivity patterns



(a)



(b)

Figure: Examples of rate-constrained directivity patterns (two different rates, two classes of coding strategies).

Conclusions & Future Work

- Efficient beamforming with few microphones
  - Perceptual factors
  - Constrained designs
- Practical coding algorithms
  - Speech-oriented
  - Interactive protocols